LONG ISLAND POWER AUTHORITY

A REPORT TO THE

LIPA BOARD OF TRUSTEES

ON THE 2009

RESEARCH AND DEVELOPMENT PROGRAM

Long Island Power Authority

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I. EXECUTIVE SUMMARY

The Long Island Power Authority (LIPA) invests in Research and Development (R&D) projects to support the strategic needs of the business, as defined by LIPA management. The goal of the R&D program is to bridge identified technology gaps between the current technological capabilities of the system, and those capabilities envisioned to be required in the future. R&D projects are designed to ensure value to LIPA and its customers in accordance with five established goals and objectives:

1. Promoting a healthy environment through leadership in efficiency and renewables;
2. Balancing the objectives of the electric resource plan with the impact on customer bills;
3. Maintaining the high reliability of the bulk electric system;
4. Maintaining the high reliability of the distribution system; and
5. Positioning LIPA to respond rapidly to change in order to manage risk.

As a general principle, the R&D program strives to conduct its projects in collaboration with other parties to leverage resources, minimize risk and incorporate best practices. In 2009, LIPA R&D was able to achieve a 7.7 : 1 leveraging of its research dollars.

LIPA's R&D program makes a positive contribution to the continuing economic development of Long Island, for these key reasons:

- R&D enables LIPA to meet its vision, mission, goals and objectives to promote the best interests of its present and future customers.

- R&D enables LIPA to economically investigate the integration of energy efficiency, renewable resources and T&D automation into a "Smart" electric system ("Smart Grid").

- The R&D program relies upon collaborative funding from other utilities, industry sources, government agencies and the private sector to leverage research dollars. LIPA has been very successful in obtaining co-funding from other organizations in past years. In 2008, LIPA leveraged $3.30 for every research dollar it spent. In 2009, LIPA was able to increase that leveraging to $7.70.

- R&D saves money for our customers. In 2009, the RD&D program is estimated to have provided $6.30 in benefits for every dollar it spent. This was achieved through avoided and deferred costs that resulted from more efficient maintenance and replacement policies, greater efficiencies and system control.

R&D promotes LIPA's goals and objectives through its many meetings and conversations with companies and ratepayers and gathers a thorough understanding customer needs throughout the service territory. This interaction fosters a clear understanding of available technology and facilitates their inclusion into LIPA's operations.

The R&D program produces real benefits for LIPA and made the following specific contributions to LIPA's customers and operations in 2009:

- **Asset Management and Utilization**: Provided LIPA with a tool for fine-tuning transmission design based on life cycle costing and supplied engineering with an evaluation report on Dynamic Thermal Circuit Rating, which allows greater utilization of these assets through a thorough understanding of the effect of real-time operational necessities on the physical life of the asset.

- **Intelligent Electronic Devices**: Provided LIPA with an evaluation of new sensor technologies and equipment, including how and where it can be incorporated into the system.

- **Local/Distributed Generation and Storage**: Provided LIPA with a feasibility analysis of using limited energy storage on the system as well as a report on distributed energy storage for pad mount or pole top transformers.

- **Energy Efficiency**: Provided LIPA with an assessment of the performance of Advanced Hydronic Heat Pumps as well as a report on the Efficiency of Consumer Electronic Devices.

- **Electric and Hybrid Vehicles**: LIPA obtained two hybrid bucket trucks as part of its on going program to evaluate more fuel efficient vehicles. LIPA has also committed to obtaining an additional two plug-in hybrid medium duty bucket trucks in 2010. In addition, the development/evaluation of medium duty plug-in hybrid power train for a transit bus was completed. The power train for the bus was successfully converted to commercial use and is now available as a commercial product in the industry.

- **Grid Planning**: Provided LIPA with forecasting tools to determine the probability of events versus their impact on the system, an Increased Power Flow Guidebook and worked to advance the development of the Common Information Model for transmission and distribution uses.

- **Advanced Materials and Methods**: Evaluated the operating experience of advanced cable designs and materials.

Going forward, LIPA is continuing to focus on the core strategies espoused in LIPA's Energy Plan to promote Energy Efficiency and Renewable Resources, and Operations projects that improve data communications and automation to support system reliability. Beyond 2010, LIPA intends to focus on addressing the technology gaps between the future needs of our customers and our present capabilities. Future R&D will predominantly focus on the areas of supporting new energy efficiency technologies, being able to integrate increasing amounts of both customer-sited and utility-scale renewable resources into the generation mix, improving the automation of the distribution system to further

increase reliability and efficiency and preparing LIPA to be able to support new large scale electric technologies such as smart grid technology, plug-in electric vehicles and other customer end use devices.

II. GOALS FOR RESEARCH & DEVELOPMENT

1. R&D STRATEGIES

In order to meet LIPA's goals as set forth in the Energy Plan in a cost-effective and technically adoptable manner, LIPA's R&D programs incorporate the following strategies:

- R&D provides practical solutions that improve system performance and enhance the operation and maintenance of the LIPA system in the immediate future.

- R&D pursues projects that directly impact a customer's ability to satisfy its energy requirements more flexibly or allow LIPA to meet a customer's energy requirements and expectations in a more flexible manner

- R&D directs projects that develop the tools, methodologies and devices needed to transform the system so that it can be managed at a higher level of reliability with lower risk to customers and at a manageable cost.

- R&D leverages funding from other utilities, industry, government, and private investment whenever possible to multiply the effects of LIPA's investment, and reduce duplicative efforts

- R&D provides leadership in industry projects which develop and demonstrate methods and devices to lower the cost profile of improving service into the future.

- R&D supports market transformation and information dissemination as the mechanism for getting the results into the hands of customers and industry stakeholders. This is done through controlled demonstrations and deployments of near-commercial technologies and collaboration with regulatory and permitting agencies. The program also provides information and education on these technologies to the local community.

- R&D incorporates the goals and objectives of LIPA's Energy Plan and the appropriate Federal, State and Local policies into R&D strategic planning.

2. COLLABORATION AND LEVERAGING

In order to maximize the value of R&D's investment, most of LIPA's R&D program is performed in collaboration with federal agencies, national and international research organizations, other utilities and academia. Through collaborative research, it is possible to

participate in research projects that LIPA couldn't otherwise afford. The table below shows the value of LIPA's funding for active and completed projects in 2009.

Source of Funding	Lifetime Spending[1]
LIPA Funding	$14,187,293
Collaborative Funding	$94,940,285
Total Funding	$109,127,578
Leveraging Ratio	7.7 to 1

LIPA's efforts with collaboration and leveraging have been most successful with the EPRI programs where the leveraging can be as high as 30:1 for projects with a large number of utility funders.

The evaluation and development of new technologies provides LIPA significant savings in the short term and in the long term. In the short term, R&D investigates new technologies in order to determine if they are ready to be placed on the system. This evaluation can often provide significant savings by avoiding products which do not perform as advertised. We also learn, and can then plan for, the effects that the technology will have on our system.

In the longer term, we participate in the development of products (equipment, procedures and software) that specifically address issues on the LIPA system. The purpose of this development is to minimize the cost of delivering electricity to our customers, and to reduce or eliminate customer outages. For example, LIPA, along with a number of other utilities, has been investigating ways to identify system faults before they occur so that they can be fixed prior to causing outages. If an outage does occur, and if we can identify the location of the problem, we can dispatch a crew directly to the location to fix the problem, saving crew time in finding the problem and reducing the amount of time that the customer is without electricity. Another example studies the effects of plug-in battery vehicles on the system. It gives our planners and engineers in-depth knowledge that will allow them to accommodate these vehicles on our grid in the most efficient and least costly manner, both for LIPA and for our customers.

Over the last five years, LIPA has re-focused its R&D program in a variety of ways, reducing its overall annual expenditures by increasing the amount of collaboration with outside organizations and leveraging the benefits of that collaboration.

[1] *The dollars listed above reflect the lifetime collaborative funding and LIPA spending on all projects that were active in 2009.*

III. 2009 STATUS

In 2009, LIPA participated in 30 separate R&D initiatives. Actual spending on R&D was a little under $3 million, approximately $245 thousand less than budgeted for the year. Budget variances for each individual project are shown on the respective project sheet in appendices A and B.

Program	Budget	Actual	Variance	No. of Projects
Customer Service / Operations	$1,074,076	$1,021,576	($52,500)	14
Energy Efficiency	$513,012	$320,970	($190,042)	16
NYSERDA	$1,600,000	$1,600,000	$0	--
	$3,187,088	$2,942,546	($244,542)	30

1. R&D PROJECT HIGHLIGHTS

The research conducted by LIPA through 2009 has enabled LIPA to move forward in its technology adoption in a number of key areas. A summary of these key accomplishments are as follows:

Asset Management and Utilization:

Advances in Asset Utilization and Asset Management techniques are lowering costs for LIPA by reducing maintenance requirements in an informed manner, and increasing reliability by enabling component maintenance or replacement before failure occurs. Projects that determine the location and type of fault automatically have enabled LIPA to speed repair times and reduce outages. The projects include the Management Maintenance Workstation and Fault Detection, Location and Identification efforts, as well as participation in EPRI's Asset Management program.

Intelligent Electronic Devices:

Intelligent devices help reduce outage times and balance system loads, as they can automatically re-configure the system, thereby reducing or eliminating outages. R&D evaluates these devices and tests those that appear to offer advantages to the system. R&D has also been involved with several research organizations that develop specifications and techniques for the use of new intelligent sensing equipment. New sensors and devices, such as Pulse Closers and GridSense sensors are starting to be used to monitor system conditions in specific locations on specific feeders.

Local/Distributed Generation and Storage:

A series of projects demonstrating the viability of small wind, solar and fuel cell generation, as well as battery storage technologies and their effect on the electric system has given LIPA an in-depth understanding of the requirements for connecting these devices to the grid. As a result, the establishment of standards and policies for connecting these devices has streamlined the installation process for both the customer and system planning and engineering. Current efforts center around distributed storage through participation in EPRI's storage program and the integration of small scale battery storage systems, primarily on plug-in hybrid electric and battery electric vehicles into the system. Past projects in small wind and solar have directly lead to the current Solar Pioneer programs and Small Wind program.

Energy Efficiency:

New technologies and equipment afford the customer an opportunity to reduce energy usage through more efficient products and by switching to more efficient energy sources. R&D evaluates these new devices and tests those that appear to offer advantages to our customers and the system. These devices often help reduce the peak load on the system by reducing or shifting energy usage. Current projects include geothermal heat pumps and ultra violet light sterilization on chiller coils, as well as EPRI's Energy Efficiency program.

Electric and Hybrid Vehicles:

LIPA has a long and influential history in the development, introduction and acceptance of electric, hybrid and plug-in hybrid vehicles. Starting in the 1970's, LIPA has conducted a series of projects geared towards promoting customer acceptance of the technology, an evaluation of the viability of the technology for internal use, and working towards the acceptance of plug-in by the major automobile manufacturers. Past projects includeed battery management systems, hybrid vehicle design and both hybrid and electric vehicle drive/lease programs. Current projects include the plug-in hybrid electric transit bus, hybrid bucket trucks and charging from a solar electric carport, as well as participation in EPRI's Electric Vehicle program. The data and experience collected in these and previous programs provide an understanding of the effects that this technology will have on the electric grid as penetration of these vehicles accelerates.

Grid Planning

An electric distribution and transmission system, and its interaction with both customers and generators, can be very complicated. A series of projects aimed at better estimating, modeling and adapting the system to real time and predicted conditions have reduced operating costs and increased reliability by reducing customer outages. Projects include Load Pocket Forecasting, and participation in EPRI's Grid Operations and Planning program.

Advanced Materials and Methods:

As new materials for cables and operational methods are developed by the industry, R&D evaluates and tests those that have the potential to provide benefits to LIPA. Through R&D, new materials used in advanced cables such as the superconductor and overhead wires projects have been and continue to be evaluated for performance, longevity and cost. New equipment and methods to increase the efficiency and quality of work practices, such as new cable splices, have also been evaluated and tested to ensure that they will perform on the system as expected. As a result, new overhead cables have been introduced to the system, as has a new family of cable connectors and installation methods for the connectors. The introduction of these advanced materials and equipment will increase system reliability and reduce maintenance costs because of their increased life spans and greater power ratings. Projects in this area include the Holbrook Superconductor project and participation in EPRI's Transmission and Distribution programs. The EPRI programs include development and testing of an Intelligent Universal Transformer, fault detection and location methodologies, an on-line monitor for dissolved gases in underground fluid filled cables and an advanced dynamic thermal rating methodology for overhead lines.

IV. VALUE ADDED SERVICES

R&D is a valuable resource to LIPA in addition to the projects previously mentioned in this report. R&D provides a technical resource for evaluating new ideas and determining solutions to both existing and new challenges. In addition, it enhances strategic planning efforts with a thorough understanding of new technologies and how it can be utilized and provide a controlled environment for demonstrating and proving near-commercial products.

During 2009, R&D provided a strategic review and recommendations for promoting electric and plug-in hybrid electric vehicles to its ratepayers. It provided its expertise to the development of the AMI and Smart Grid programs and was consulted for high technology solutions to several distribution reliability problems.

Other value added services are realized though leveraging participation in other organizations, which can contribute to projects being conducted in LIPA's service territory which benefit LIPA's ratepayer, sometimes at no or reduced cost to LIPA.

R&D collaborates with other national, regional and local organizations and groups sharing similar purposes, to advance its strategic goals. LIPA is nationally recognized for its leadership role in a variety of R&D projects. These groups and organizations include:

- New York State Energy Research and Development Authority (NYSERDA)
- U. S. Department of Energy (U.S. DOE)
- U.S. Department of Transportation (U.S. DOT)

- Local, Regional and National Technical and Environmental Organizations
- Counties – Suffolk, Nassau, Queens (Rockaways)
- Local Long Island Towns and Cities
- Local Colleges, Universities and School Districts
- Local Private Companies

Maintaining close relationships with these organizations have resulted in advancing LIPA's goals within our service territory. A few examples are:

- Greater Long Island Clean Cities Coalition – Member of the Board of Directors, which can steer strategy efforts for the organization and evaluated independent proposals which, when implemented, reduce the carbon footprint and greenhouse gas emissions. These efforts have resulted in obtaining co-funding and promoting the use of alternate fueled vehicles on Long Island.

- Advanced Energy Research Technology Center's (AERTC)Technology Forum – Co-sponsored the technology forum on Long Island with Brookhaven National Laboratory, Stony Brook University, and National Grid. The technology forum emphasized our role as innovative leaders working with local congressional leaders in advancing technology in our electric system, resulting in the creation of new companies with jobs remaining on Long Island. In addition, LIPA management participates as a member of the AERTC's Board of Directors.

- DV 2010 – Participation in this distribution development company has resulted in a demonstration of a fault locating and identification technology on LIPA's system, bringing critical experience on the implementation aspects of this technology. In addition, it has provided new distribution system control methodologies which are currently being evaluated for use on LIPA's system.

V. R&D PLANS FOR 2010 AND BEYOND

LIPA has maintained its R&D spending for 2010, while continuing to focus on its core strategies. These strategies include developing new methods and technologies to improve reliability and safety while at the same time minimizing rates and environmental impacts. R&D also strives to collaborate with other utilities, research organizations and academia in order to leverage both financial and intellectual resources to maximize the value received from R&D.

In 2010, LIPA intends to focus R&D activities in the Energy Efficiency and Renewable Resources area on evaluating small PV installations, battery storage technologies and electric transportation. These activities are being performed both in collaboration with EPRI and local organizations.

In Customer Services, and Operations, R&D activities in 2010 will focus on fault indication and location detection, advanced transmission cables, evaluating the inclusion of hybrid and plug-in hybrid service vehicles into the fleet and looking at technologies and methods to build and operate the electric system more efficiently and with less loses. These activities are being performed both in collaboration with EPRI and local organizations.

Energy Efficiency and Renewables Program	
Miscellaneous Projects	$267,474
Efficiency Projects	$40,000
Renewable Projects	$263,526
NYSERDA	$1,600,000
EE Approved Budget	**$2,171,000**

Customer Services and Operations Program	
Miscellaneous Projects	$157,114
EPRI Programs	$696,200
EPRI Supplemental Projects	$40,000
CS/O Approved Budget	**$893,314**

Total 2010 R&D Budget	**$3,064,314**

At the same time, LIPA will leverage its leadership position on several other initiatives, in particular the Smart Grid, on order to keep abreast of industry advancement in these areas while moving toward participation in leveraged projects to provide a continuing level of value to the customer.

Beyond 2010, LIPA's intentions for R&D are to focus on addressing the technology gaps between the "customer of the future" and the "system of the future" versus our present capabilities, and to further the development of energy efficiency, integrating renewable resources into the generation mix, and automating the distribution system to improve efficiency and reliability. R&D will continue leveraging research dollars through collaborative efforts with EPRI and other organizations in order to maximize benefits for LIPA without incurring increasing R&D costs.